Aug. 12, 1958 P. W. KASEMAN 2,847,599

BULB SPACER SHIELD

Filed Jan. 9, 1956

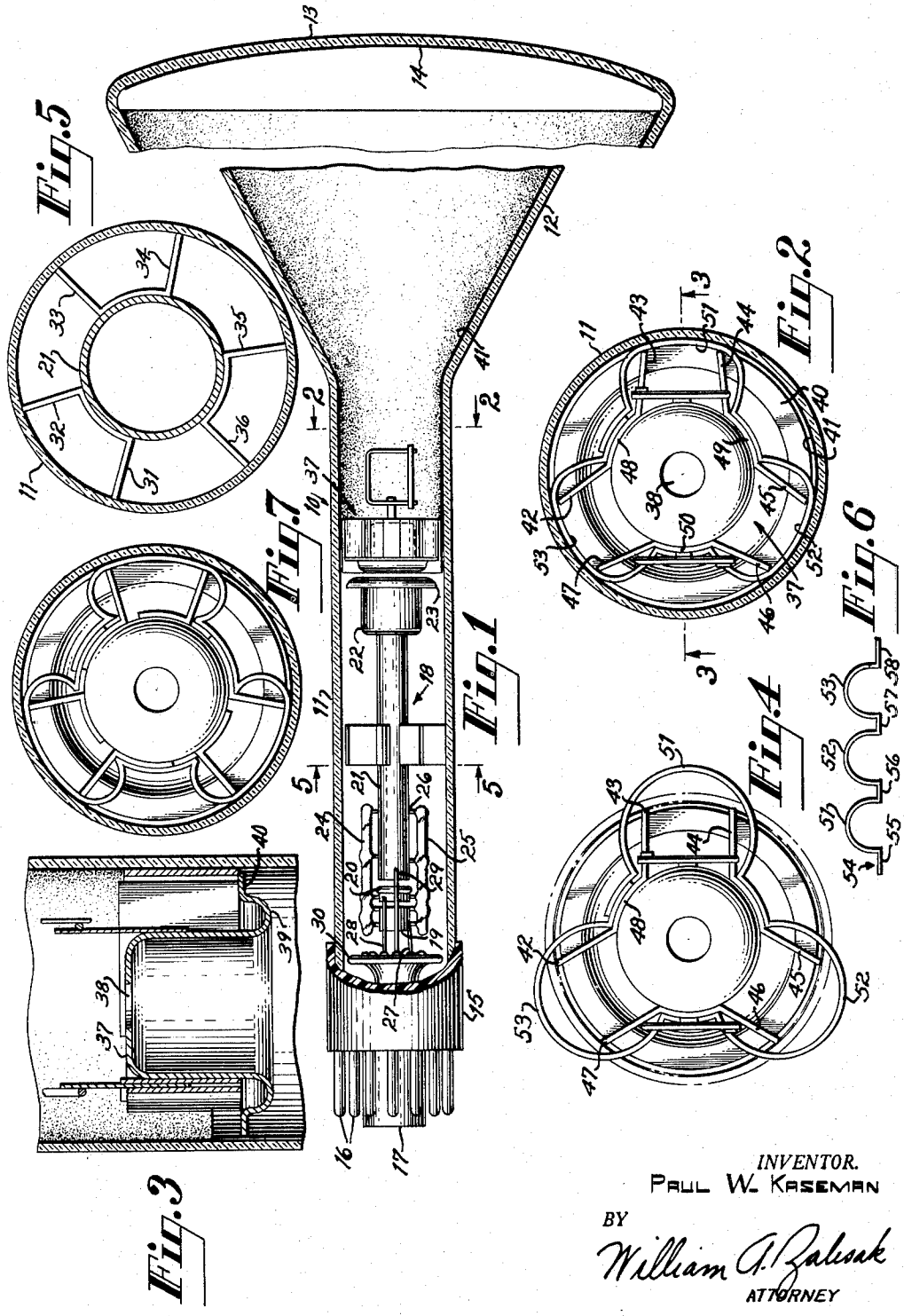


Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

INVENTOR.
PAUL W. KASEMAN
BY
William A. Zalesak
ATTORNEY

United States Patent Office 2,847,599 Patented Aug. 12, 1958

2,847,599

BULB SPACER SHIELD

Paul Warren Kaseman, Lancaster, Pa., assignor to Radio Corporation of America, a corporation of Delaware

Application January 9, 1956, Serial No. 558,019

13 Claims. (Cl. 313—82)

This invention relates to electron tubes, and more particularly it relates to electrode arrangements and supports for us in such tubes.

A principal object of the invention is to provide an improved organization of elements for maintaining in accurate operational alignment, the electrodes of an electron array, such for example as the electrodes of an electron gun.

Another object is to provide an improved electron gun of the kind having at least one electrode which is to be concentrically supported within the tubular portion of any well-known enclosing bulb, for example within the neck portion of a cathode-ray tube.

A further object is to provide a precise and rugged electrode spacer and shield device which is particularly advantageous in supporting an electrode within a tubular glass member such as for example the neck portion of a bulb.

The invention is in the nature of an improvement on the electron gun incorporating an electrode support and centering device such as disclosed in the United States Patent 2,793,312 of Nevin R. Hangen and Richard H. Hughes, dated May 21, 1957.

In the Hangel et al. Patent 2,793,312 referred to immediately above there is disclosed an electron gun including in longitudinal alignment a cathode-grid assembly, a second grid, a first tubular metal anode, a second anode in the form of a conductive coating on the internal surface of the neck of the enclosing glass envelope. For the purpose of focussing the electron beam which exits from the first anode, and also for the purpose of providing a barrier extending across the said neck except at the central region where the beam passes, there is provided a composite beam focussing and shield electrode which is supported within the tube neck, independently of the remaining electrodes. The said focusing and shielding electrode is arranged to be frictionally held within the tube neck, by means of a series of outwardly extending thin walled metal ribs or fins whose outer edges frictionally engage the inner surface of the glass neck and also make conductive electrical contact with the second anode coating on the interior surface of said neck. Because of the fact that each of said fins engages the glass in a sharp knife-like linear contact area, when the second anode is operated at a very high voltage such as is common in cathode-ray tubes of the projection kind, there is an exceedingly high concentration of voltage gradient at the knife-like contact areas, and that may result in a puncturing of the glass wall of the neck by dielectric breakdown. That condition is very likely to occur if the glass neck is provided with a conductive coating on its external surface, or if it has in contact therewith adjacent said knife-edge contact areas, a member which is at ground or similar low potential with respect to the second anode. Such a breakdown condition is aggravated if the internal surface of the glass is scratched or otherwise weakened, for example at the points where the said focusing electrode is inserted.

Accordingly, it is a feature of this invention to provide a novel support device for a high voltage electrode, which support is adapted to be in close contiguity with the glass wall of an enclosing bulb, whereby the likelihood of high voltage puncturing of the glass is greatly reduced.

Another feature relates to a novel spacer and centralizing support arrangement for an electrode, comprising a series of support fins attached to the electrode, which fins are shielded by a thin-walled flexibily deformable loop or series of loops, to increase the gripping area on the glass, while at the same time avoiding the concentration of large dielectric stresses which would otherwise occur between the edges of said fins and the glass.

A further feature relates to an electrode centering and support arrangement of the kind employing a series of thin metal fins which extend outwardly from the electrode towards the glass wall of the bulb which surrounds the electrode; in conjunction with a series of metal loops which are flexibly distortable in a radial direction with relation to the electrode so that they provide an extended frictional gripping area with respect to the bulb wall, while at the same time reducing the dielectric stresses between the said wall and the relatively sharp edges of said fins. Furthermore, as a result of the smoothly rounded contour of the said loops, the chances of the glass wall being scratched during the insertion of the electrode into the bulb, are greatly reduced.

A further feature relates to an electrode carrying a series of support fins which extend outwardly from the electrode toward a glass wall, for example, the neck of a cathode-ray tube; and a strip of thin flexible metal which is formed into a series of flexibly deformable loops and with each loop interposed between a corresponding pair of fins and the said glass wall.

A still further feature relates to the novel organization, arrangement, and relative location and interconnection of parts which cooperate to provide an improved electron gun, especially a gun to be operated at high voltages on the second anode, such as in well-known cathode-ray tubes of the projection kind.

Other features and advantages will appear as the following descriptions ensue.

While the invention will be described in connection with one particular construction of cathode-ray tube, it will be understood that the advantages of the invention can be realized in a wide variety of electron tubes, wherein one or more electrodes are to be firmly anchored in place by frictional engagement with the wall of an enclosing bulb or envelope. Accordingly, in the drawing,

Fig. 1 is an elevational view, partly sectional, of a typical cathode-ray tube embodying the invention.

Fig. 2 is an enlarged sectional view of Fig. 1, taken along the line 2—2 thereof, and viewed in the direction of the arrows.

Fig. 3 is a sectional view of Fig. 2 taken along the line 3—3 thereof, and viewed in the direction of the arrows.

Fig. 4 is a view similar to that of Fig. 2, but showing an electrode with its support and shielding means, prior to insertion of the assembly within the tube neck.

Fig. 5 is an enlarged sectional view taken along the line 5—5 of Fig. 1 and viewed in the direction of the arrows.

Fig. 6 is a diagrammatic view explanatory of one manner of forming the shield element according to the invention.

Fig. 7 is a modification of the invention.

Referring to the drawing, the numeral 10 represents any well-known form of electron tube, which is illustrated as a conventional cathode-ray tube or kinescope, provided with an enclosing evacuated envelope having a neck portion 11, joined to a flared bulb portion 12, the latter being closed off at its forward end by the flattened viewing face or end wall 13. Wall 13 may have attached to its inner face any well-known fluorescent coating 14 which acts as a transducing screen for the electron beam and by means of which the screen is scanned in any well-known manner. The opposite end of the neck 11 is closed off by the usual header or stem through which are sealed in a vacuum-tight manner, the various lead-in wires for applying suitable electric potentials to the various electrodes within the envelope. Any suitable plug-in base 15 may be externally attached to the neck 11, and if desired the usual contact prongs 16, and the centering boss 17 may form part of the base.

For the purpose of developing the scanning beam, there is mounted within the neck 11, any well-known form of electron gun 18. The gun may comprise the usual cathode-grid assembly 19 for producing an electron beam whose intensity can be modulated by the electric signals applied to the control grid of the cathode-grid assembly. Mounted adjacent the assembly 19 is another grid electrode 20 which may serve as a beam defining and shielding grid. Likewise, mounted adjacent grid 20 is a first or low voltage beam-accelerating anode 21 which may be in the form of an elongated metal tube carrying at its forward end a cup-shaped metal member 22 formed with a rounded lip 23. The elements 19, 20, 21, 22 are rigidly interconnected in insulatingly spaced array, in any well-known manner, for example by a set of elongated glass beads 24, 25 into which are sealed the ends of short metal extensions 26, fastened to the respective electrodes. These electrodes are supported at the left-hand end as seen in Fig. 1, by having their respective lead-in and support wires 27, 28, 29 sealed into the glass header or pedestal 30.

Since the gun 18 is of considerable length and weight, it is usually necessary to support it against tilting movement with respect to neck 11. For that purpose, the anode 21 has attached thereto around its periphery a set of six thin metal fins 31–36 which are moderately flexible. In the particular example shown, the fins are arranged in three sets, each set, for example 31, 32, being formed from a thin metal sheet bent to substantially V-shape with the base of the V welded or otherwise fastened to the outer face of the anode 18. Normally, that is before the gun is inserted into the neck 11, the fins of each set 31, 32; 33, 34; 35, 36 angularly diverge so that they are non-radial. Thus, when the gun is inserted into the neck 11, the fins of each set flexibly engage and press against the inner face of neck 11 and they spread somewhat apart. Since the fins of each set are substantially V-shaped and are of equal radial length, and since they are symmetrically located around anode 21, they serve flexibly to support the gun centrally within the neck 11.

Mounted in closely spaced relation with respect to the forward end of member 22 is a shielding and beam-focusing electrode 37 which, as shown in Fig. 3 may be in the shape of a metal cup having a central beam-passing opening 38 in the cup bottom, facing the member 22. The lip of electrode 37 is turned back upon itself to form a rounded contour 39 terminating in a flat flange 40 whose outer diameter is slightly less than the internal diameter of neck 11. Thus electrode 37 forms a barrier across substantially entirely across the neck 11, except of course, at the beam-passing aperture 38.

In accordance with the invention the electrode 37 is held within the neck 11 independently of the remaining electrodes of the gun. Furthermore, the electrode 37 forms part of the second accelerating anode system which includes the conductive coating 41 on the inner face of neck 11 and on the inner face of bulb 12, which coating terminates short of the fluorescent coating 14. The coating 41 is provided with the usual contact button (not shown) which is sealed through the wall of the bulb 12 and makes contact with the coating 41. Since the electrode 37 must necessarily be operated at a high potential, for example, of the order of thousands of volts, it is necessary that a positive and firm electrical contact be maintained between the electrode 37 and the coating 41. The electrode 37 can be flexibly supported and centered within the neck 11 by a series of six flexible diverging thin metal fins 42—47 which may be similar to the fins 31—36 hereinabove described. Adjacent diverging fins of each set, for example, fins 42, 43 may be formed from a sheet of thin flexible metal having an arcuate yoke 48 welded or otherwise fastened to the outer cylindrical face of electrode 37. Likewise, the arcuate yokes 49, 50 of the remaining pairs of fins 44—45 and 46—47 are welded to the electrode 37 with the centers of the yokes located 120 degrees apart.

Normally, that is before the electrode 37 is inserted into the neck 11, the angular divergence between adjacent fins 42, 43 may be approximately 120 degrees, and the radial lengths of said fins is such that the diameter of the circle circumscribing the free ends of the fins, and as represented in Fig. 4 by the dot-dash circle, is slightly greater than the internal diameter of the neck 11. The result is that when the electrode with its fin supports is inserted into the neck 11, the fins of each set are flexibly spread apart and provide a firm flexible pressure contact with the coating 41. The manner of supporting the electrode 37 by the diverging fins is described in the aforementioned United States patent to Hangen et al., 2,793,312.

Since the support fins 42, 47 have substantial length considered along the axis of the neck, and since they are of thin sheet metal, they engage the coating 41 in narrow or knife-like contact lines. I have found that under certain conditions of operation, the knife-like linear contact between the fins and the glass neck, may result in puncturing of the glass wall of the neck. Furthermore, the frictional gripping area and actual electric contact area, are of course restricted to the said knife-like areas at the edges of the fins. Since it is necessary to flex the diverging fins further apart when inserting the assembly within the neck, I have found that the knife-like edges of these fins, has a tendency to scratch the glass surface of the neck. Furthermore, the sharp edges of the fins may remove a part of the coating 41 and reduce the efficiency of electrical contact therewith.

While the accidental scratching of the glass neck may not be objectionable for ordinary or low voltage uses, it becomes of considerable importance when an element at ground potential is mounted adjacent the tube neck externally thereof and adjacent the electrode 37. For example, when the electrode 37 is operated at a very high potential, for example of 20,000 volts, and if a grounded element is located adjacent the said electrode externally of the neck, there is an exceedingly high concentration of potential gradient distributed over a very limited area of the glass where it is contacted by the edges of the fins. This may result in a puncturing of the glass. The likelihood of such puncturing is aggravated if the glass has been scratched or is inherently weak dielectrically at regions of such high potential stress.

I have found that the above-noted difficulties can be overcome by providing an additional gripping and contact enlarging member which cooperates with the fins to distribute the voltage stress over a much larger area of the glass neck, while at the same time increasing the effective gripping area. For that purpose the fins of each pair, for example 43, 44; 45, 46; 47, 42 are surrounded

by respective flexible metal loops **51, 52, 53.** Preferably, although not necessarily, these loops can be formed from a single strip **54** (Fig. 6) of somewhat flexible sheet metal and having a moderate degree of springiness. The strip **54** can be bent to form the three substantially semi-circular loops **51, 52, 53** with intervening unbent portions **55—58.** The formed strip is then bent to a three-lobed cloved shape, with each lobe enclosing a coresponding pair of fins, and with portions **55—58** welded or otherwise fastened to the respective arcuate portions **48, 49, 50** of the fin supports.

As will be seen from Fig. 4, the loops **51, 52, 53** are of sufficient size so that normally they do not engage the outer edges of the respective fins which they enclose. Consequently, when the assembly is inserted within the glass neck **11,** the loops are flattened in a radial direction and make continuous and correspondingly large area contact with the coated neck, by conforming themselves to the shape of the neck, as shown in Fig. 2. During the flattening of the loops, attendant upon the insertion into the neck **11,** the said loops engage the outer edges of the respective pairs of diverging fins which thereupon increase their angular divergence. As a result, the loops **51, 52, 53** act as corona shields for the edges of the fins, while at the same time they increase the electrical contact area, and the gripping area, over what such area would be in the absence of the loops.

It will be understood that it is not necessary to make the loops from a single sheet of flexible metal. The loops may be formed individually and fastened to the electrode **37** as separate elements. However, by using a single sheet of flexible metal, it is possible to design the loops with a much higher degree of uniformity, while reducing the cost of assembly. Furthermore, while the invention has been described in conection with a set of six fins, arranged in three pairs, it will be understood that a greater or lesser number of pairs of such fins can be used, and a correspondingly greater or lesser number of loops for shielding those fins can likewise be used.

Likewise, if desired, the fins can be made as separate elements and individually attached to the periphery of electrode **37,** as illustrated in Fig. 7. In some cases shielding and gripping loops may also be used in connection with the fins **31—36** which support the gun **18,** although such may not be necessary because of the relatively lower voltage that is employed on the electrode **21.**

Finally, it will be understood that the contact and gripping arrangement of the invention, can be used in a wide variety of electron tubes which have enclosing envelopes of tubular or similar shape wherein one or more electrodes are to be frictionally held and centered. Consequently, various changes and modifications can be made in the described embodiments and still come within the purview of the invention.

What is claimed is:

1. An electron discharge device comprising an envelope having a curved inner surface, an electrode within said envelope, and electrode locating means comprising a plurality of flexible fin members carried by said electrode and extending into close proximity with said curved inner envelope surface, and a flexible loop enclosing said fins and contacting the ends of said fins, said loop having part of its periphery curved in the same sense as said inner surface and in contact with said inner surface.

2. An electron discharge device comprising an envelope including a tubular portion having a curved inner surface, an electrode within said tubular portion, and electrode locating means comprising a plurality of flexible fins carried by said electrode and extending into close proximity with said curved inner surface, and a flexible loop enclosing a pair of adjacent ones of said fins and contacting the ends of said pair of fins, said loop having a part of its curved, periphery conforming to the curvature of said inner surface and in contact therewith.

3. An electron discharge device comprising an envelope including a tubular portion having a curved inner surface, an electrode with said tubular portion, and electrode locating means comprising a circular array of flexible metallic fins carried by said electrode and extending into close proximity with said curved inner surface, and an array of flexible sheet-metal loops located between said inner surface and said array of fins and contacting the ends of said fins, each of said loops enclosing a different one of said fins, each of said loops having a portion of its outer periphery curved along a substantially length of said inner surface and in spring pressing contact therewith and having other portions extending away from said inner surface.

4. The invention as in claim 3 wherein each loop contacts a pair of adjacent ones of said fins.

5. An electrical discharge device comprising an envelope, a plurality of electrodes within said envelope, and means to locate and maintain one of said electrodes in a desired position in spaced relation to another electrode, said means comprising a plurality of flexible thin metal fins carried by said electrode and extending therefrom in symmetrical array around the electrode and into close proximity with the inner wall of said envelope, and a plurality of thin flexible metal loops also carried by said electrode, each loop enclosing a pair adjacent fins and having its periphery located between the ends of said pair of fins and said inner wall to provide in conjunction with said fins a frictional gripping area against said inner wall which is many times greater than the area of contact between each fin and said inner wall in the absence of the loop.

6. An electrical discharge device comprising an enclosing envelope having a tubular portion, and means to locate and frictionally maintain one of said electrodes in fixed spaced relation to another electrode, said means comprising a plurality of flexible metal fins carried by said one electrode and located symmetrically around the electrode and extending therefrom in a non-radial direction into close proximity with the inner wall of said envelope to centralize the said electrode within said tubular portion, and a plurality of flexibly deformable thin metal loops with each loop surrounding a corresponding adjacent pair of said fins and having its median portion in flexible pressure contact with the said inner wall.

7. An electrical discharge device according to claim 6, in which each of said loops is normally of greater radial size than the radial length of the fins, whereby each loop is flexibly flattened by engagement with the said inner wall when said electrode is inserted into said tubular portion so as to increase the area of contact between the loop and said inner wall.

8. An electrical discharge device according to claim 6, in which each of said loops is normally formed with a predetermined curvature which is less than the curvature of the said inner wall whereby the loop is constrained by the associated pair of fins to conform itself to the curvature of the said inner wall when the electrode is inserted in said tubular portion.

9. An electron discharge device of the kind which operates with a focussed beam of electrons, comprising an enclosing envelope having a substantially cylindrical neck portion, an electron gun having a plurality of electrodes for defining said beams, one of said electrodes being mounted within said neck portion independently of an adjacent electrode and arranged to be supported by frictional gripping contact with the inner wall of said neck portion, said inner wall having an electrically conductive coating, and means to locate and maintain said one electrode within said neck while making contact with said coating, the last-mentioned means including a plurality of pairs of flexible fins symmetrically located around and attached to said one electrode and arranged to centralize said one electrode within said neck, and a plurality of thin flexible metal loops also carried by said

electrode, each of said loops enclosing a corresponding pair of said fins, each loop normally extending beyond the ends of said fins but being flexibly flattened to conform to the curvature of said neck, and each loop having its flattened curved portion in contact with said coating.

10. An electron discharge device comprising an envelope having a tubular neck portion, a series of longitudinally spaced electrodes within said neck portion, one of said electrodes being mounted in said neck independently of the mounting of the remaining electrodes, and means to locate and centralize said one electrode within said neck, the last-mentioned means comprising a plurality of pairs of flexible fins symmetrically attached around said one electrode, each pair of fins extending in a diverging direction into close proximity to the inner surface of said neck to provide a series of equally spaced pressure points against said neck, and a strip of flat flexible metal attached to said one electrode and being bent into distinct loops and with each loop enclosing a corresponding pair of said fins, each loop being flexibly flattened and in flexible pressure engagement with said inner surface of the neck and with the corresponding pair of said fins.

11. A focussing and shielding electrode for insertion within the tubular neck of an enclosing envelope, comprising a cylindrical metal member having an annular flange of approximately the same diameter as the neck diameter to form a barrier across said neck said member having an opening for the passage of an electron beam, a plurality of flexible metal fins fastened symmetrically around the periphery of said cylindrical member and

with each pair of adjacent fins defining a substantially outwardly diverging V-shaped support, and a flexible thin metal strip bent to form a plurality of discrete loops, each loop normally extending radially outward from the center of said cylindrical member to distance which is substantially greater than the radius of said neck, whereby each loop is deformed to a flattened shape when the electrode is centralized within said neck with each loop in flexible pressure contact with its corresponding pair of fins and with the inner wall of the neck.

12. An electrode for high voltage electron tubes, comprising a tubular metal member, a plurality of flexible fins attached symmetrically around said member and defining a plurality of sets of substantially V-shaped supports, and a shield for the outer edges of said fins, said shield comprising a thin metal strip attached to said electrode and being bent to form a plural-lobed member with each lobe enclosing a corresponding pair of fins.

13. An electrode for high voltage electron tubes, comprising a tubular metal member, a plurality of flexible fins attached symmetrically around said member, and a shield for the outer edges of said fins, said shield comprising a thin metal strip attached to said electrode and being bent to form a loop enclosing the ends of said fins.

References Cited in the file of this patent

UNITED STATES PATENTS

2,323,140	Lane	June 29, 1943
2,432,037	O'Larte	Dec. 2, 1947
2,562,242	Pohle	July 31, 1951
2,658,161	De Ano	Nov. 3, 1953